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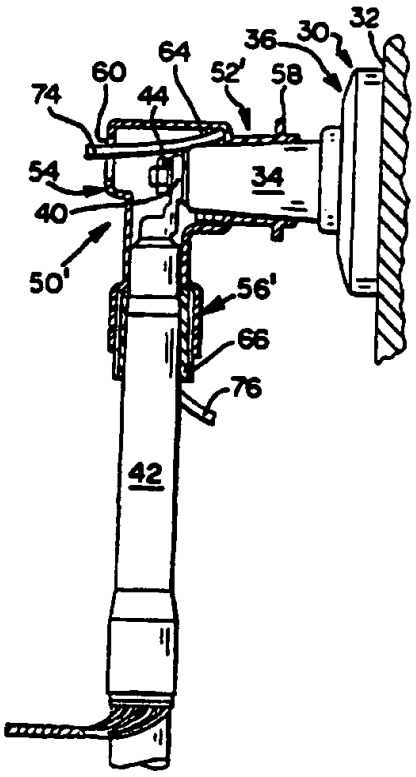
(54) Title: PRESTRETCHED MODULAR BARRIER BOOT

(57) Abstract

A resiliently deformable T-shaped end closure cap (50') of electrically insulating elastomeric material for cable terminations which connect a cable (42) to an equipment terminal with said terminal extended through an insulator body having an annular sealing surface and being adapted to form a cable core terminal, said end cap comprising an open forward end portion (52') adapted to be sealingly shifted onto said insulator body, a rearward open end portion (54'), and a finger portion (56') branching off from said closure cap (50') between said end portions and adapted to be shifted onto said cable (42), characterized in that said forward end portion (52') and said finger portion (56') are adapted to be held in a radially expanded state by separate approximately hollow cylindrical support cores (64, 66), with said support cores (64, 66) being formed by a coiled strip, said cores being unwound and removed by pulling an end portion (74, 76) of said strip which is extended back through the interior of said cores (64, 66).



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PRESTRETCHED MODULAR BARRIER BOOT

The invention refers to a resiliently deformable, approximately T-shaped end closure cap of electrically insulating material for electrical cable terminations.

PRIOR ART

Particularly in connection with electrical switching implements or the like it is frequently required to connect the equipment terminals with a cable such that the connection is effectively insulated and sufficiently protected against the penetration of moisture. The equipment terminal normally includes an insulator body, e.g. as a part of a feed-through means in a wall which provides an annular sealing surface, e.g. in the form of an outer cone. A T-shaped insulating closure cap for an electrical cable termination has become known from the DE 32 48 212, wherein the cable end including the connection lug is introduced through the stem of the T-shaped closure cap on an inner cone of a transverse arm cooperating with an outer cone of an insulator body. The T-shaped insulator cap has a relatively thick wall of relatively stiff material.

From the DE 32 33 572 a T-shaped closure cap has become known with the cable end including the connection lug being introduced through the stem thereof. One end of the transverse arm is formed with an outer cone, and the opposite end is formed with an

inner cone. The inner cone cooperates with an outer cone of the insulator body of the equipment terminal. The transverse arm is hollow and receives the threaded connection means for the connection lug. In the known embodiment the T-shaped body defines a kind of modulus such that one T-shaped body is used for each cable connection. The known electrical cable termination connector, however, is expensive to manufacture. The sealing of the T-shaped insulating body against the equipment insulator body or against a second T-shaped insulator body, respectively, is achieved by the conical engagement of the parts, as described. Thus, the conical surfaces must be precisely formed in order to achieve the desired sealing effect preventing the penetration of moisture. Further, the T-shaped insulator body is relatively solid, and thus consumes a corresponding amount of material.

From the DE 38 02 435, a relatively thin walled closure cap for cable termination connectors has become known which consists of resiliently deformable material. It has also a T-shape and the stem is sealingly shifted onto the cable. The transverse arm of the T-shaped end closure cap is formed as a cylindrical sleeve which is partially closed at both ends by a radial flange. The inner circumference of the radial flanges forms an annular surface. The surface of the forward end portion cooperates with the sealing surface of the conical equipment insulator body. An easily removable plug is inserted into the

other opening. The plug can be easily removed to allow a threading attachment of the lug to the insulator body. Further, the open end of the cap permits access to the lug for test purposes. Such an end closure cap is relatively easy to manufacture. Since it is made of relatively thin material, the inventory of material is relatively small. However, it is relatively difficult to mount to cap portions onto the cable and the insulator body, respectively.

In the US 3,515,798 a mechanical support means is disclosed to hold a radially expanded sleeve, e.g. for cable connections, in a radially expanded state. To this purpose a support coil of plastic material is used, with the adjacent windings inter-connected by a weakened portion. An end portion of the coil is extended back through the hollow cylindrical core to the opposite end so that upon a pulling of the end portion the support coil is unwound. Due to the inherent tension, the sleeve for example can be shrunk onto a cable connection (cold shrinking). The structure of the support coil necessitates a rotating of the unwound strip about the item onto which the enclosure is to be shrunk. Owing to missing space, this meets frequently to difficulties. Therefore, from W093/22816 is has become known to form a support core from a flexible sheet, preferably of plastic material, with opposing edges of the sheet including means to interlock the edges under maintenance of the cylindrical shape when the sheet is wrapped to form a

hollow cylinder. The sheet has a series of substantial parallel lines of localized weakening extending from one of the opposite edges to a point near but short of the other of the opposite edges, with successive lines extending from alternate edges to define a strip beginning at a free end and continuing in a serpentine length between and around consecutive lines. When the end of the core is pulled, the core reverses the breaking direction by 180° at each return section.

In both cases, the support cores are designed to support elongated tubular articles of elastomeric material.

SUMMARY OF THE INVENTION

The invention refers to a resiliently deformable T-shaped end closure cap of electrically insulating elastomeric material for an electrical cable termination which can be easily applied to the cable termination and which contemporatily allows the installation of the electrical connection without particular measures and auxiliary means.

In the end closure cap according to the invention, the forward end portion and the finger portion are radially expandable and are held in a radially expanded state by a hollow cylindrical support core prior to the installation of the closure cap. With the invention, it has been recognized that also T-shaped end closure caps can be cold shrunk by means of mechanical removable support means. This considerably facilitates

the installation of the closure cap. Furthermore, the cold shrinking of a stretched closure cap effects a very good sealing and prevents the penetration of moisture to the electrical connection. Finally, the closure caps of given dimensions can be applied to a larger range of diameters.

The end portion of the strips of the support coils are brought out in a suitable manner, e.g. through the open end of the finger or the rearward end portion, respectively. The expense for the mechanical support is relatively small. Furthermore, the individual relatively short support cores can be removed quickly.

In the invention, the closure cap first is shrunk onto the cone of the equipment terminal in that the respective support core is removed e.g. with the end portion of the strip extending through the open end of the rearward end portion. Thereafter, the electrical connection of the lug of the cable core with the equipment terminal is established, e.g. the threading operation can be carried out through the open end of the rearward end portion. Finally, the finger portion is shrunk onto the cable also by removing the associated support means. The removal of the support coil out of the forward end portion may be somewhat difficult. An embodiment of the invention provides the application of a support core which is disclosed by the W093/ 22816 and described above in more detail.

According to an alternative solution of the invention, a T-shaped closure cap can be shrunk onto a

cable termination connector in that both the forward end portion and the finger portion are held in a radially expanded state by a single extended support core. Forward end portion and finger in their relaxed state extending at an angle therebetween are approximately aligned coaxially by the single support core. By a partial removal of the support core first the forward end portion is shrunk onto the outer cone of the equipment terminal, with the closure cap bending back to its original shape. Thereafter, the electrical connection of the cable core is established. Finally, the remaining support core is removed, whereby the finger portion is shrunk onto the cable.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is hereinafter explained in detail along embodiments of the invention illustrated by drawings, where

Fig. 1 shows a first embodiment of a closure cap according to the invention in a non-expanded state,

Fig. 2 shows the closure cap of Fig. 1 in an expanded state

Fig. 3 shows partially in cross section the application of the closure cap of Figs. 1 and 2 to a cable termination connector,

Fig. 4 shows a perspective view of the final insulation of the closure cap of Figs. 1 and 2 to the cable termination connector,

Fig. 5 shows a perspective view of a second embodiment of a closure cap of the invention,

Fig. 6 shows the closure cap of Fig. 5 in an expanded state, and

Fig. 7 shows the closure cap of Figs. 5 and 6 in a mounted state on a cable termination connector.

DETAILED DESCRIPTION OF THE DRAWINGS

In Fig. 1 a closure cap 50 can be seen which is substantially T-shaped and includes transverse arms 52, 54 with the latter being significantly shorter than the first one. A finger-shaped stem 56 branches off between the transverse arms 54, 52. Stem 56 extends perpendicular to the transverse arms 52, 54. Transverse arms 52, 54 and finger 56 are tubular, with the forward arm 52 formed with an annular radially outwardly extending rib 58, and the shorter transverse arm 54 having a circular opening 60 at the free end thereof. Finger 56 is provided with a portion 62 having an enlarged diameter at the free end thereof.

As can be seen in Fig. 2 arm 57 is maintained in a radially expanded state by a support core 64. The radially expanded arm is designated with 52'. Finger 56' is held by a support coil 66 in an expanded state after being radially expanded through a known device. The support core 64 is known from the W093/22816 which is described above in more detail. It consists of a flat sheet of plastic material, with opposing parallel edges thereof being provided with interlocking means 68

to hold the sheet in a cylindrical form after being brought to a tubular shape. By weakening lines 70 which alternatingly extend from opposing edges and which extend nearly to the each other opposite edge, a serpentine continous strip 72 is formed, with an end portion 74 thereof extended back through the interior of the core through arm 52 and arm 54 beyond opening 60 as shown in Fig. 2. The support coil 66 is also known, e.g. from US 3,515,798 as described. Such a support coil is generally known and thus needs no explanation. An end portion of the support coil 66 is returned from the free end as shown at 76.

In Fig. 3, the closure cap 50' is partially applied to a sleeve 34 of feed-through means 30 in that a tension force is applied to the strip end portion 74. Support core 64 is not unwound by rotation, rather, the strip makes partial circular movements about 180°. Therefore, a lug 40 of cable 42 can be attached prior to the final removal of core 64. A nut can be actuated through opening 60 and tightened. It is also possible to remove support core 64 completely prior to the attachment of lug 40 by means of nut 44. Thereafter, support coil 64 is completely removed. Then, the removal of support coil 66 takes place by pulling the strip end portion 76. By this, finger portion 56' is shrunk onto the exterior of cable 42. This can be seen in Fig. 4.

In Fig. 4 it can be seen further that opening 60 is closed by a plug 78. It is mounted into opening 60

by a snapping connection and, thus, can be easily removed, e.g. to allow access to the electrical connection for test purposes.

Finally, in Fig. 4 can be seen that a sleeve 80 is shifted onto the end of cable 42, with the sleeve of insulating elastic material having axially spaced annular ribs 82. Such sleeve can be also shrunk onto the cable by a support coil.

Closure cap of Fig. 5 is identical with that of Fig. 1. Therefore, it is designated with 50a. Also the other reference numbers correspond to that of Fig. 1 only added by an "a". The embodiment shown in Fig. 5 is also manufactured for example by injection molding of a suitable elastomeric polymer as the embodiment of Fig. 1.

In Fig. 6, it is shown that end closure cap 50a of Fig. 5 is bent such that finger 56a and arm 52a are approximately coaxial for the accommodation of a throughgoing support coil 84, with an end portion thereof being led back through the interior thereof as shown at 86.

During installation, first the forward end portion 52a', is shrunk onto sleeve 34 of feed-through means 30 by a partial removal of support coil 84. By this, the closure cap 50a restores approximately to the angular shape of Fig. 5 so that upon a shifting on cable 42 lug 40 of cable core can be attached through opening 60a. Finally, the remaining support coil 84 is removed in

order to shrink finger portion 56a' onto the cable or onto the sleeve 80a already mounted, respectively.

CLAIMS:

1. A resiliently deformable T-shaped end closure cap of electrically insulating elastomeric material for cable terminations which connect a cable to an equipment terminal with said terminal extended through an insulator body having an annular sealing surface and being adapted to form a cable core terminal, said end cap comprising an open forward end portion adapted to be sealingly shifted onto said insulator body, a rearward open end portion, and a finger portion branching off from said closure cap between said end portions and adapted to be shifted onto said cable, characterized in that said forward end portion and said finger portion are adapted to be held in a radially expanded state by separate approximately hollow cylindrical support cores, with said support cores being formed by a coiled strip, said cores being unwound and removed by pulling an end portion of said strip which is extended back through the interior of said cores.

2. The end closure cap of claim 1, wherein said strip of said core supporting said forward end portion is extended back through said open end of said rearward end portion.

3. The end closure cap of claim 1, characterized by the application of a support core which comprises of a flexible sheet, preferably of plastic material which is provided with interlocking means at

opposing edges to maintain the cylindrical form after wrapping said sheet to a hollow cylinder, with weakening lines alternatingly extending from opposing edges toward the other opposing edge and form serpentine strip.

4. The end closure cap of claim 3, wherein said support core is applied to said expanded forward end portion.

5. The end closure cap of claim 1, wherein said strip end portion of said support core for said expanded finger portion is extended through the end of said expanded finger portion.

6. The end closure cap of claim 1, wherein said strip end portion of said support core for said expanded finger portion is extended through the open end of said rearward end portion.

7. The end closure cap of claim 1, wherein said rearward end portion is adapted to be closed by a cap.

8. A resiliently deformable T-shaped end closure cap of electrically insulating elastomeric material for cable terminations which connect a cable to an equipment terminal with said terminal extended through an insulator body having an annular sealing surface and being adapted to form a cable core terminal, said end cap comprising an open forward end portion adapted to be sealingly shifted onto said insulator body, a rearward open end portion, and a finger portion branching off from said

closure cap between said end portions and adapted to be shifted onto said cable, characterized in that both the forward expanded end portion and the expanded finger portion are held in a radially expanded state by a single elongated support core, with the forward end portion and the finger portion being brought to a coaxial alignment after being bent out of the original relaxed shape.

9. The end closure cap of claim 8, wherein said strip end portion of said support core is extended through the end of said expanded finger portion.

10. The end closure cap of claim 8 or 9, characterized by the application of a said support core which comprises a flexible sheet, preferably of plastic material which is provided with interlocking means at opposing edges to maintain the cylindrical form after wrapping said sheet to a hollow cylinder, with weakening lines alternatingly extending from opposing edges approximately toward the other opposing edge and form a continuous serpentine strip.

11. The end closure cap of claim 8, wherein said rearward open end portion is adapted to be closed by a cap after removal of said support core.

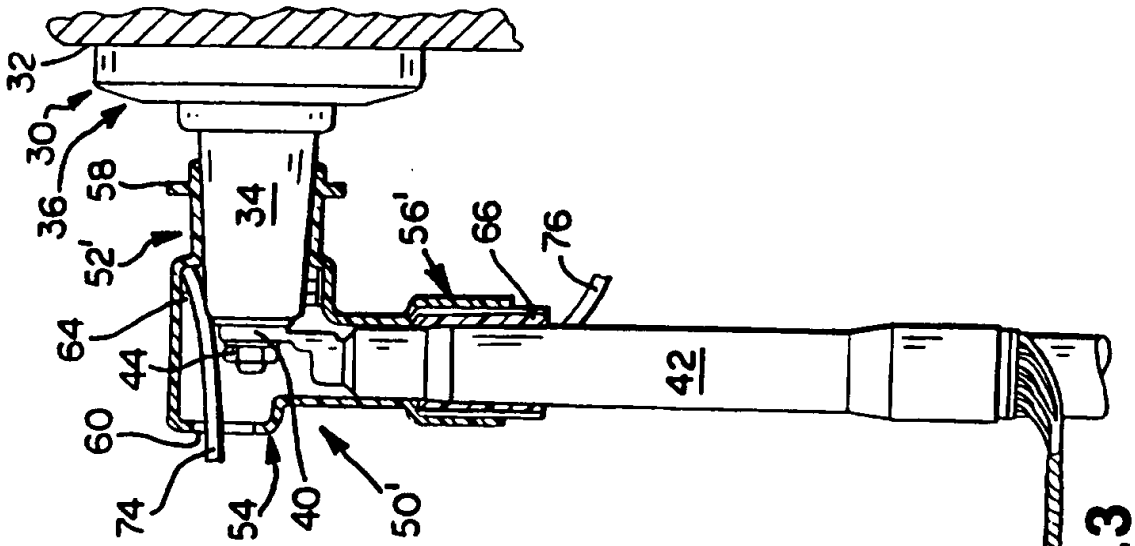


FIG.3

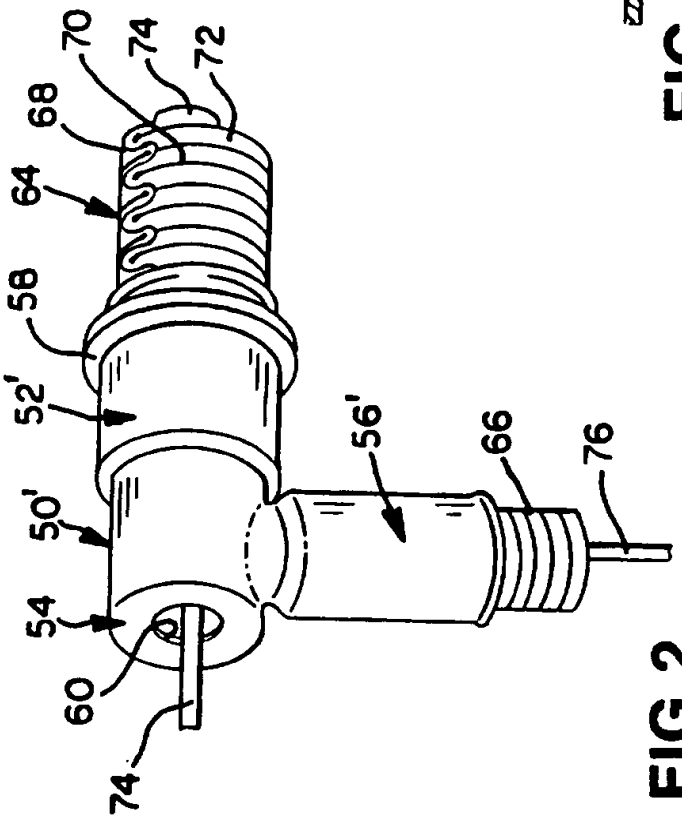


FIG.2

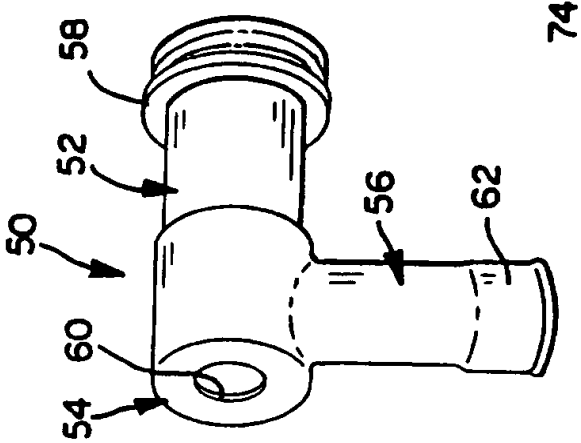


FIG.1

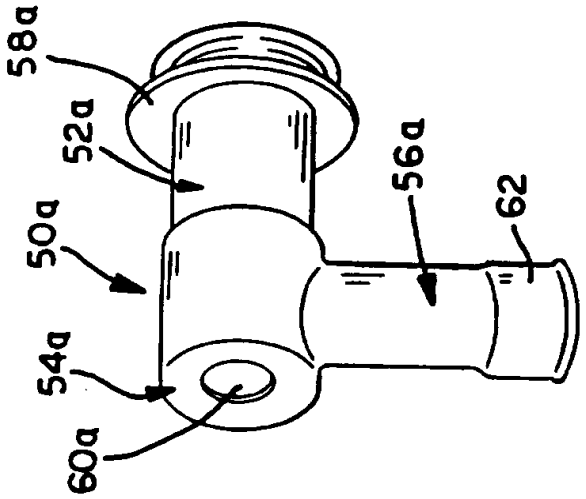
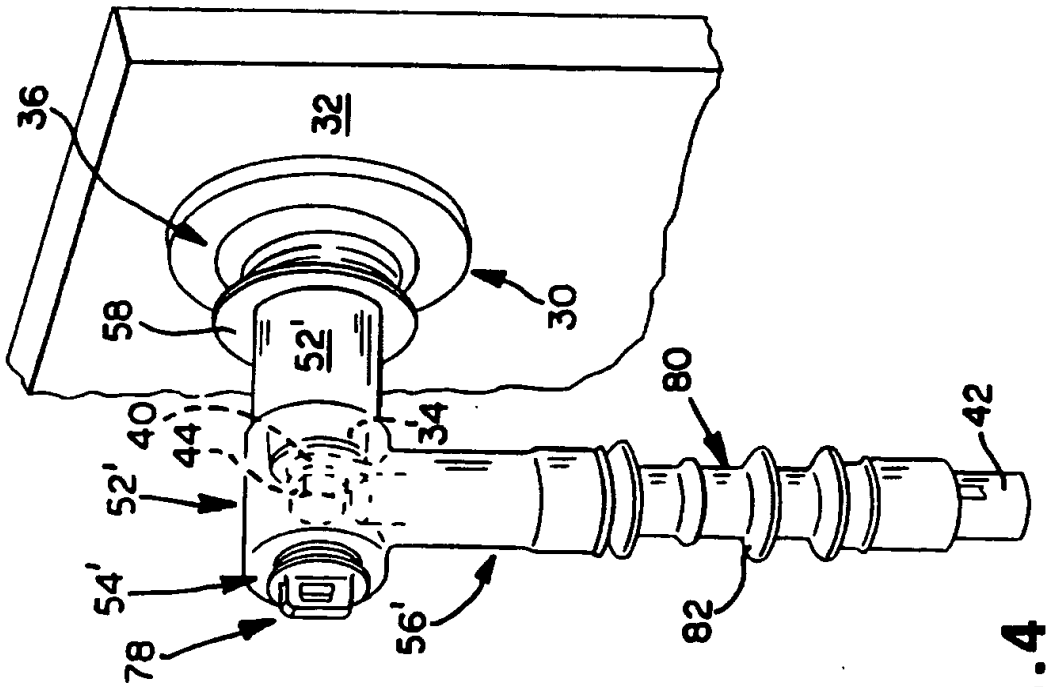

58a
52a
56a
62
50a
54a
60a

FIG.5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58
52'
80
42
40
44
34
52'
54'
78
56'
82

FIG.4

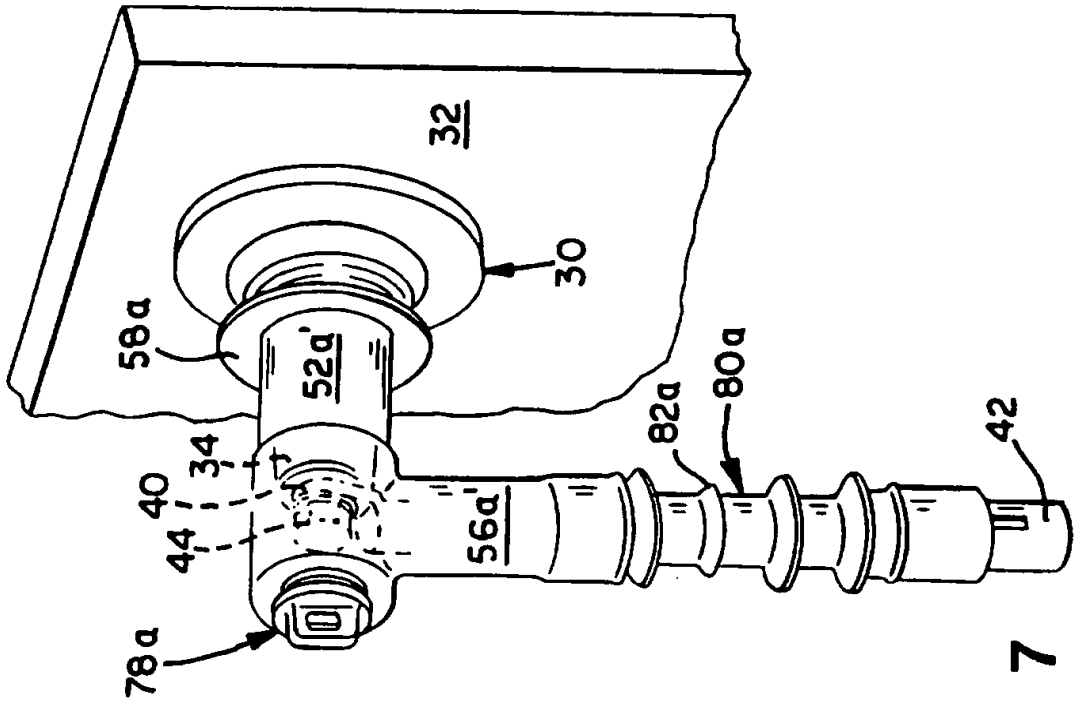
32
30
58a
52a'
34
40
44
56a'
82a
80a
42
78a

FIG. 7

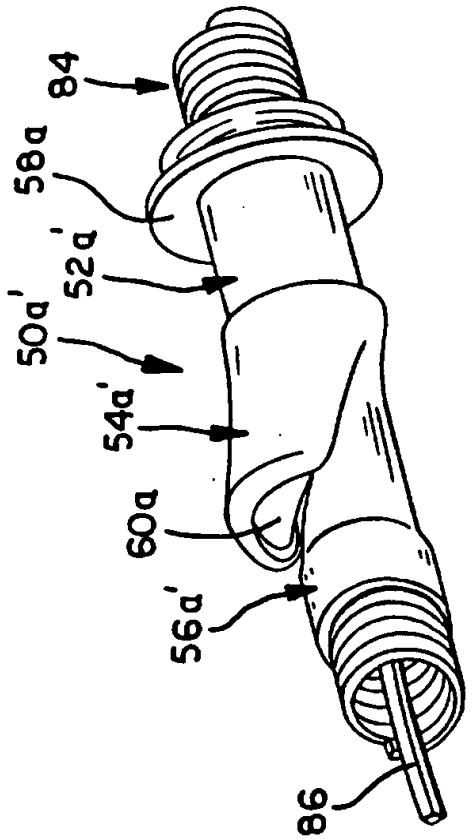
84
58a
52a'
50a'
54a'
60a
56a'
86

FIG.6

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 95/15621

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02G15/064 H02G15/184 H02G15/18 H01R13/53

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02G H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	EP,A,0 504 035 (PIRELLI) 16 September 1992 see column 4, line 45 - column 5, line 24 see column 6, line 20 - line 35; figures 1-3,5	1 8
Y A	WO,A,94 22196 (MINNESOTA MINING AND MANUFACTURING COMPANY) 29 September 1994 see page 2, line 7 - line 9 see page 2, line 29 - line 35 see page 3, line 4 - line 9 see page 5, line 22 - line 34; figures 2,3	1 4
A	EP,A,0 547 656 (PIRELLI) 23 June 1993 see abstract; figure 1	1,4

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer Lommel, A

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 95/15621

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,93 22816 (MINNESOTA MINING AND MANUFACTURING COMPANY) 11 November 1993 cited in the application see abstract; figures 1,2	1,3,4,10
A	DE,A,32 48 212 (FELTEN & GUILLEAUME ENERGIETECHNIK) 5 July 1984 cited in the application see abstract; figure 1	1,7,8,11
P,X	WO,A,95 29524 (MINNESOTA MINING AND MANUFACTURING COMPANY) 2 November 1995 see page 6, line 10 - page 7, line 27; figures 4,5	1,4,5

2

INTERNATIONAL SEARCH REPORT

information on patent family members

Inter nal Application No
PCT/US 95/15621

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0504035	16-09-92	FR-A-	2674073	18-09-92
		DE-D-	69207238	15-02-96
		US-A-	5230640	27-07-93
WO-A-9422196	29-09-94	AU-B-	6131494	11-10-94
		CA-A-	2156165	29-09-94
		EP-A-	0689728	03-01-96
EP-A-0547656	23-06-93	IT-B-	1252219	05-06-95
		CA-A-	2084936	17-06-93
		DE-D-	69204637	12-10-95
		US-A-	5486388	23-01-96
WO-A-9322816	11-11-93	JP-A-	5303985	16-11-93
		AU-B-	3973293	29-11-93
		CA-A-	2133322	11-11-93
		EP-A-	0638210	15-02-95
DE-A-3248212	05-07-84	NONE		
WO-A-9529524	02-11-95	AU-B-	7840194	16-11-95